

What's the Big Question?

How can genetic technology help improve people's lives?

The world is getting smaller. Not really, but it seems that way. Every day, more and more people are born, and more people means more houses and towns. This population growth leaves less land for farming—for growing food. The more people Earth has, the less room it has to grow food.

Thomas Malthus, a British **economist** who lived in the 1700s, wrote that people would increase faster than the supply of food available for their needs. Thus, they would soon run out of food. He argued that if a farmer needs more food, he can add one more acre to his farm, then one more, then one more, until he runs out of land. But he cannot make more land. Meanwhile, if the farmer and his wife have four children, and each of his children have four children, and they each have four children, the family will increase from six, to eighteen, to sixty-six in only three generations. Soon his farm won't be able to grow enough food for the entire family. And farmers in many parts of the world have more children than four, because they need more people to work on the farm.

genetics: the science of how characteristics are passed from one generation to the next.

economist: a person who studies the economy.



Thomas
Malthus

technology: science that can be applied to everyday life.

What Malthus thought would come true may come true—some day—but not as soon as he expected. Since the 1700s when Malthus lived, scientists have worked on this problem. They have developed **technology**, not to add more land for growing food, but to use the land the farmer has to grow more food and better food.

Many people in the world already face the problem Malthus wrote about—they can't grow enough food. One of the foods they have trouble growing enough of is rice. For you, rice may be one among many other foods you might eat. But for millions of people in the world, rice is the main food source and a way of life. Many of these people have to produce the rice they consume. Sometimes the harvest is good, and a farmer can feed his family. He might even have enough extra rice to sell. Other times, the crops might be destroyed by bad weather or pests, and the family may go hungry. What farmers need is a new kind of plant that can resist bad weather and bugs, and produce more rice and more nutritious rice, year after year.

Scientists are working on developing new and better rice plants. To develop a new plant, they need to understand what makes one rice plant different from another. They also need to know the effect the environment has on how the plants grow and develop. They can then use this knowledge and new technologies to grow better plants.

In this Unit, you will conduct the same kind of investigations scientists do. Read the bulletin on the next page to learn more about the problem scientists are trying to address and the role you will play in helping them.

*Welcome to Genetics!
Enjoy being a student scientist.*



Research Announcement

To: All Interested Scientists

From: The Rice for a Better World Institute (RBWI)

Subject: Request for research collaboration

The Rice for a Better World Institute (RBWI) is dedicated to improving rice plants to help farmers around the world grow more productive rice plants.

We have had some successes in the past, but we need to address a new and bigger problem now. The world population is growing fast. Our task is to address this situation by developing rice plants that will feed more people.

With the help of genetic technology, we have already developed several new varieties of rice. Each variety has **traits** that help it grow well in particular environments and under particular conditions. But for the future, we must develop new plants to address the problems rice farmers are facing.

We invite you to join the team of researchers and farmers in the Philippines working on this project. We will keep you updated on the progress of our research from time to time. You will also receive from the farmers, the results of the field experiments.

trait: a physical or behavioral characteristic of an individual that can be passed down to the next generation.

Identify Criteria and Constraints

In this Unit, your challenge will be to make recommendations about developing a new rice plant that will produce more rice and more nutritious rice. Before you start, it's a good idea to make sure you understand the criteria and constraints of your challenge. Criteria are things that must be satisfied to achieve the challenge. In this case, the rice plant you develop must produce more rice and more nutritious rice than the plant the farmers are now using. Constraints are factors that limit how you can solve the problem. You can't grow the rice in your classroom. The farmers must grow the rice in their own fields. You can only suggest ways for the scientists working with the farmers to develop the new rice plant. The farmers can carry out any field experiments you need to

conduct. Think about other constraints that may affect your solution. Record your criteria and constraints in a table like the one below so you can refer to them as you move through the Unit.

Make recommendations about developing a new rice plant that will produce more rice and more nutritious rice	
Criteria	Constraints

Think about the *Big Question*

In this Unit, you will answer the *Big Question* by addressing a *Big Challenge* that will make recommendations about developing a new rice plant that will produce more rice and more nutritious rice. Before you try to answer a *Big Question* or work to address a *Big Challenge*, it is useful to think about what you might already know.

You will carry out two activities to assist you in organizing your thinking. They will help you understand the importance of rice and the problems faced by farmers who grow it.

Get Started



Caution!
Do not eat
the food

Your class will look at some foods and samples of different grains. Each of the foods is made from one of the grains in your samples. Work with your class to identify the foods, and match each food with the grain used to make it.

1. Record the name of each grain at the top of a sticky note. Then, on each sticky note, list the foods made from that grain.
2. Now, work by yourself to continue the list you began on each sticky note. Think of other foods made from each grain in your set. Try hard to think of foods made from each grain that people in other countries might eat. List each food on the correct sticky note.
3. Continue to work by yourself, and think about how important each of the grains is as a food source by adding more information to your list:
 - How often do you eat each of these foods? Do you eat them every day, once a week, only occasionally, or never? Next to the name of each food, record how often you eat it.
 - If you don't eat a food, but you know it is a big part of other people's diets, record how often you think people eat each type of food.
4. Use your list for evidence, and answer these questions:
 - How important do you think each type of grain is as a food source? Think about how many people in the world might use it to make the foods they eat most often.
 - Which grains do you think are more important than others?

Materials

- ¼ cup each of: oats, corn, rice, and wheat
- Samples of foods made from different grains



Conference

Which grain do you think is the main food source for the greatest number of people in the world? Share your sticky notes with each other. Listen carefully as others in your group present their ideas. Ask your group members for the evidence that supports their ideas. Be sure you are respectful of others' opinions. Come to an agreement as a group on which grain you think feeds the most people. Be prepared to share your answer and your reasoning with the class.

Communicate

As a class, make a list of the foods you know of that are made from each grain. For each, discuss what you know about how many people in the world depend on that grain for food. Which grain do you think is the main food source for the greatest number of people in the world? Each group should get a chance to share their answer and their reasoning. You'll learn the answer to this question later in the Unit.

A Letter from the Philippines

Hello.

My name is Amihan. I live in the Quezon province, in the Philippines. I am nine years old. I have two brothers and two sisters.

Rice is very important in our lives. We eat it three times a day. Even my favorite dessert is made with rice. Every year, on May 15, we have a festival to celebrate the rice harvest.



This year we are lucky. We have plenty of rice to eat. My teacher said there are too many people in Asia, and there is not enough rice for them to eat. Some of our neighbors are very poor, and sometimes they don't have enough rice.

When there is lots of rice, my parents are happy. But last year, when the harvest was not very good, my father almost had to sell the farm to get some money. My father says he cannot tell anymore when the rains will come. Sometimes they don't. Then there is no rice crop.

insecticide: a substance used to kill insects.

Even when the rains come, insects may harm the rice. My father used to spread insecticides. But one day he became sick. The doctor told him that insecticides are poison.

My parents seem worried. Something that no one understands is happening to our rice field. My parents say that every year they have to put more fertilizer on the fields to grow the same amount of rice. But the price of rice stays the same, so we get less money.

Two months ago, some scientists from the city came to our farm. They told my parents that they were trying to make a new rice plant. They hope the new rice will grow even when the weather is poor. And bugs will not eat the new rice, so my father will not get sick from spraying.

The scientists want my father to help them. They will give us the seeds to plant in the fields. When the new plants grow, we will tell the scientists how much rice we get.

I am happy the scientists are helping us. If we can grow more rice, we can have more money and live better.

Thank you.

Amihan





Stop and Think

1. What are the problems faced by the rice farmers? List at least three problems rice farmers have.
2. How do you think scientists might help the farmers? Describe one way the scientists might help the farmers solve their problems.
3. How do you think farmers might help the scientists? Describe how the farmers might help the work of the scientists.

Communicate

Share with the rest of your class your ideas about the problems faced by the rice farmers and how you think scientists might help them. Make sure you also present your ideas about how the farmers might help the scientists. Listen carefully as others present their ideas. Make sure you understand what other students think are the major problems for farmers who grow rice and the ways scientists might help solve them.

Revise Criteria and Constraints

Now that you've thought about the problems rice farmers are facing, revise your list of criteria and constraints. What characteristics do their rice seeds need to have so the farmers will have enough to eat and be able to make money selling their crop? List these as criteria. What problems do they have to manage? List these as constraints.

Think, too, about what questions are important to investigate to address the *Big Challenge* and answer the *Big Question*.

Create a Project Board

When you are trying to answer a hard question or working to solve a hard problem, it is helpful to organize your work.

You will be using a *Project Board* throughout this Unit to keep track of your progress and the things you still need to do. Your teacher or another student will record the class's ideas on the class *Project Board*. You will use your own *Project Board* to keep track of your work.

How can genetic technology help improve people's lives?

Make recommendations about developing a new rice plant that will produce more rice and more nutritious rice.

What do we think we know?	What do we need to investigate?	What are we learning?	What is our evidence?	What does it mean for the challenge or question?

Remember that the *Project Board* has space to answer five guiding questions:

- *What do we think we know?*
- *What do we need to investigate?*
- *What are we learning?*
- *What is our evidence?*
- *What does it mean for the challenge/question?*

To start this *Project Board*, identify and record the *Big Question* and *Big Challenge* for this Unit:

Big Question: How can technology help improve people's lives?

Big Challenge: Make recommendations about developing a new rice plant that will produce more rice and more nutritious rice.

What do we think we know?

In the first column of the *Project Board*, record what you think you know about the problems faced by the rice farmers and how a new rice plant might help them.

How do you think rice is grown? Think about why the farmers may need a new plant to solve their problems. Why can't they continue to plant the rice they have? Share your ideas about what the advantages might be of developing a new rice plant.

Discuss what you know about the work of scientists who develop new plants. What do the scientists need to do? Don't worry if you don't know the answer. Think about what you would do if you were that scientist. Scientists work in different ways when trying to solve a problem. It is important to discuss the different ideas they might have. Often by putting together the best ideas that come up during their discussions, scientists find a better way to address a problem.

What do we need to investigate?

Use this column to record what you need to investigate to address the challenge and answer the *Big Question*. Perhaps not all students in your class agree on the main problems farmers face in growing rice. Or maybe you and other members of your class have different opinions about how scientists can help the farmers.

Use this column to keep track of what you would need to investigate to address the *Big Challenge*. Make sure you also record what you are not sure about and need to learn more about.

You will return to the rest of the *Project Board* later in the Unit. For now, work with your class members to fill in the first two columns.